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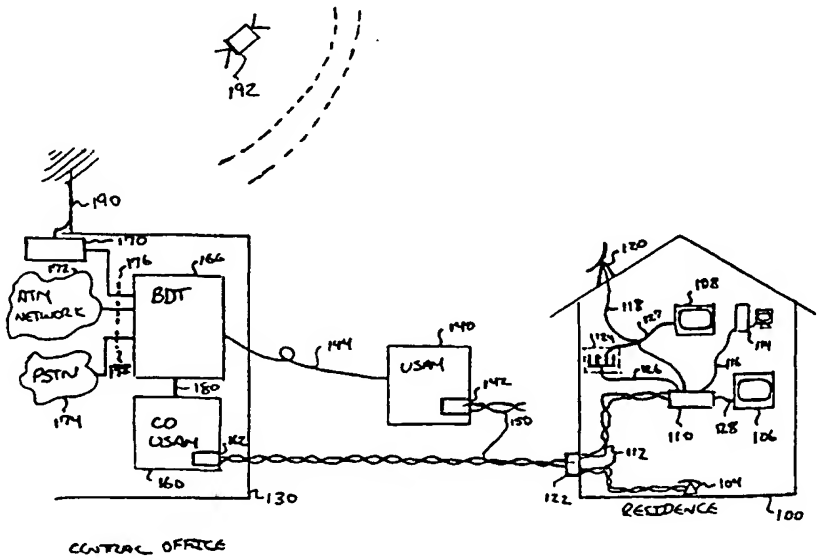
(54) Title: WIRELESS AND xDSL RESIDENTIAL GATEWAY AND SYSTEM



(57) Abstract: Device, system, and method for receiving broadcast and switched digital signals through a main host residential gateway (110) and distributing received signals to devices (108, 114, 106) in a home. A main host residential gateway (110) receives signals from a broadcast source (170) which may be a satellite, LAN-based wireless transmitter or other broadcast source. The main host residential gateway also interfaces to a switched network (172). The gateway (110) can decode and demodulate the broadcast and switched digital signals and transmit the signal to devices using coaxial cable, twisted pair, or other medium.

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Wireless and xDSL Residential Gateway and System

by

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Cross Reference to Related Application

This application claims priority to provisional application No. 60/142,778, filed July 8, 1999, the entirety of which is incorporated herein by reference.

Background of the Invention

A number of different types of distribution systems are utilized for transporting video signals to residences including over-the-air-broadcasting, cable television systems (also known as Community Access Television (CATV) systems), wireless distribution systems including Multichannel Microwave Distribution Systems (MMDS) and Local Microwave Distribution Systems (LMDS), and Direct Broadcast Systems (DBS) which are based on satellite transmissions. These systems are broadcast in nature since they transmit a number of channels to groups of subscribers, with the channel selection being performed locally at the subscriber television or television set-top box. Broadcast systems have the advantage that they can provide a large number of channels to a large number of subscribers at the relatively low cost. The drawback of broadcast systems is that although some broadcast systems

can provide a substantial number of video selections, they are ultimately limited in the number of channels which can be transported.

DBS systems have another drawback in that they cannot easily provide access to local television channels. Transmitting local channels through the satellite would involve sending the local stations to a set of subscribers which is much larger than those in the local broadcast area. Transmitting all of the local stations through the satellite would require much more bandwidth than is available in the satellite transponder.

Alternate architectures for the delivery of video programming include Switched Digital Video (SDV) architectures in which the subscriber channel selection is transmitted to a central switching location, and an individual channel is transmitted to the subscriber. The SDV architecture has the advantage that any channel can be provided to the subscriber, thus providing potentially unlimited video selections.

One difficulty in implementing an SDV architecture is that a high-speed digital connection to the subscriber residence is required. Developments in digital transmission technology allow high-speed data signals to be transmitted over twisted wire pairs, either directly from a telephone central office, or from a terminal in the neighborhood. This technology, generically called Digital Subscriber Line (DSL), allows for transmission at data rates of up to an exceeding 25 Mb/s, but the transmission rate which is achievable is heavily dependent on the length

of the twisted wire pairs. Many DSL connections only support data rates in the range of 5-7 Mb/s, and only permit the transmission of a single, Standard Definition Digital Television (SDTV) channel. This precludes simultaneous reception of multiple channels at the home, as well as the reception of multiple channels at the home, as well as the reception of High Definition Television (HDTV) signals.

For the foregoing reasons, there is a need for a video transmission system and apparatus that supports SDV functionality while simultaneously utilizing the benefits of broadcast technology.

Summary of the Invention

In the present invention broadcast signals are received from a satellite, wireless, or other broadcast source at a gateway device located in the residence. The gateway device also has a connection to a twisted wire pair, coaxial cable, or other transmission medium which supports switched digital video services. Upon receiving a channel request, the gateway determines if that channel is available in the broadcast stream or if it must be requested for transmission over the SDV network. In a preferred embodiment, an authorization request is sent from the gateway to a centralized control unit to determine if the subscriber has authorization to receive the channel. If the channel is available on the broadcast stream, the gateway is sent an authorization message to permit decoding the channel at the gateway for presentation to the subscriber. If the channel is not available from the broadcast stream, a request is made for the channel from the SDV network, and the channel is transmitted over the SDV transmission path.

In a preferred embodiment the DSL transmission system is an Asymmetric Digital Subscriber Line (ADSL) connection which supports data rates of up to 6 Mb/s over loop lengths of 12,000 ft. This permits the ADSL modems to be located in the telephone company central office or in an access terminal which is remote from the neighborhood. Other DSL systems include Very High-Speed Digital Subscriber Loop (VDSL) transmission. Various DSL systems are often collectively referred to as "xDSL."

An advantage of the present invention is that local channels can be provided over the SDV network, with broadcast channels provided via satellite. This coupling of the SDV network with the satellite distribution system solves the long-standing issue of how to provide local channels in DBS systems. Another benefit of this architecture is that it does not burden the SDV system with broadcast channels (such as popular network programming) which can be readily provided by the satellite system. Yet another advantage is that multiple channels can be simultaneously received using the hybrid satellite/SDV system, as opposed to a stand-alone SDV system using ADSL, which has bandwidth limitations due to the use of twisted wire pairs.

In the present system HDTV signals can be provided via the satellite system, where a number of premium channels can be broadcast in HDTV format. The DSL system is not burdened with providing HDTV signals.

In an alternate embodiment the DSL system is HDTV capable and HDTV signals can be received over the broadcast or SDV network.

In the present invention data and telephone services can be provided in conjunction with the broadcast video system by using the SDV platform and associated telephone plant for voice and data, while receiving broadcast signals over the satellite, wireless, or cable network. This allows display of data on the television without requiring a two-way broadcast network. Low data rate DSL systems

such as G.lite can be utilized for data services while receiving video over the broadcast network.

In a preferred embodiment, the SDV system supports channel authorizations, software downloads to the gateway, and other data centric functions, freeing the broadcast network from these requirements. This allows a simplified security system to be utilized at the gateway, since channel changes are authorized in the SDV system at a centralized location.

In an alternate embodiment the gateway determines if the requested channel is present in the broadcast stream and obtains authorization locally at the gateway. This allows use of a traditional satellite or wireless security system.

Another feature of the present invention is that bandwidth demands are reduced throughout the entire SDV system including switching elements and fiber optic transport, since many of the channels selected are available from the broadcast stream.

In a preferred embodiment the present invention is realized as a gateway processor on a single integrated circuit which supports processing of multiple digital video channels, independent of the media over which the signal is received.

Another feature of the present invention is the ability to distribute video signals from a gateway device to remote receivers using existing in-home twisted wire pairs. This permits transmission of signals to remote devices without requiring the rewiring of the home.

These and other features and objects of the invention will be more fully understood from the following detailed description of the preferred embodiments that should be read in light of the accompanying drawings.

Brief Description of the Drawings

The accompanying drawings, which are incorporated in and form a part of the specification, illustrate the embodiments of the present invention and, together with the description serve to explain the principles of the invention.

In the drawings:

FIG. 1 illustrates a wireless and xDSL residential gateway and system;

FIG 2. is a use case diagram illustrating the functionality of the wireless and xDSL residential gateway;

FIG. 3 is a use case diagram illustrating the functionality of the wireless and xDSL control system;

FIG. 4 illustrates a sequence diagram for channel authorization in a wireless and xDSL residential gateway;

FIG. 5 illustrates an architecture for a wireless and xDSL residential gateway;

FIG. 6 illustrates an architecture for a flexible media gateway device; and

FIG. 7 illustrates an in-home distribution system using a wireless and xDSL residential gateway with distributed receiving devices.

Detailed Description of the Preferred Embodiment

In describing a preferred embodiment of the invention illustrated in the drawings, specific terminology will be used for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes all technical equivalents that operate in a similar manner to accomplish a similar purpose.

With reference to the drawings, in general, and FIGS. 1 through 7 in particular, the apparatus of the present invention is disclosed.

FIG. 1 illustrates one embodiment of the present invention in which a DSL system is used in conjunction with a satellite transmission system. Although the broadcast system of FIG. 1 is a satellite based system, the invention is not limited to satellite based broadcasts but can be used with a variety of broadcast systems including over-the-air transmission systems, MMDS or LMDS wireless networks, cable networks, or any other broadcast system in which multiple channels are simultaneously transmitted to a plurality of subscribers.

In FIG. 1 satellite 192 transmits a signal which is received by residence 100 using a satellite/wireless antenna 120. A switched digital network is also in place and is comprised of a Broadband Digital Terminal (BDT) 166, which receives signals from an ATM network 172 through a broadband interface 176, as well as receiving telephone signals from a Public Switched Telephone Network (PSTN) 174 through a narrowband interface 178. In one embodiment the BDT 166 is connected to a remotely located Universal

Service Access Multiplexer (USAM) via an optional fiber 144. USAM 140 contains a Very High-Speed Digital Subscriber Line (VDSL) modem 142 which connects to a residence via outside plant twisted wire pairs 150. In this embodiment the VDSL modem 142 supports data rates up to an exceeding 25 Mb/s over loop lengths of up to 3,000 ft. The BDT 166 is capable of supporting multiple USAMs 140 using a plurality of optical fibers 144 or using a passive optical network. USAM 140 supports a plurality of subscriber connections and can accommodate multiple VDSL models 142.

The switched digital network illustrated in FIG. 1 is capable of providing voice, video and data services to residence 100. In providing telephone services calls are received via PSTN 174 at BDT 166 and are transmitted to CO USAM 160 and through ADSL model 162 to residence 100. In a preferred embodiment ADSL modem 162 contains circuitry for generating an analog voice signal which is transmitted over outside plant twisted wire pairs 150 and which his received at NID 122 which separates out the voice signal and transmits it to telephone 104. Data services are received via ATM network 172 and are transmitted from BDT 166 to CO USAM 160 through ADSL model 162 over outside plant twisted wire pairs 150 and to a getaway 110 located in residence 100. Gateway 110 provides an interface to computer 114 via a gateway-computer connection 116 which in a preferred embodiment is Ethernet over twisted wire pairs. In this way data services are provided to the residence.

In the embodiment illustrated in FIG. 1 switched digital services are provided directly from the central office 130 to the residence 100 by an Asymmetric Digital Subscriber Line (ADSL) modem 162 which is connected to a Network Interface Device (NID) 122 at residence 100 via outside plant twisted wire pairs 150. ADSL modem 162 is located in a Central Office USAM (CO USAM) 160 which is connected to BDT 166 via a BDT-CO USAM connection 180. Central office 130 also contains an off-air antenna 190 which receives the over-the-air broadcasts including local television channels. In alternate embodiments the local programming is received at central office 130 via another type of wireless connection, through a data network, or via ATM network 172. As shown in FIG. 1 signals received from the off-air antenna 190 are transmitted to an off-air receiver/decoder 170 which converts the analog signals to digital signals. In a preferred embodiment the off-air signals are converted to Motion Pictures Expert Group (MPEG) packets contained in an ATM transport stream.

Video services can be provide over the switched digital network by receiving video programming either from off-air receiver/decoder 170 or through ATM network 172 at BDT 166. BDT 166 switches packets or cells containing video to CO USAM 160 which transmits the requested video channel over outside plant twisted wire pairs 150 to gateway 110 through NID 122 and over in-home twisted wire pairs 112.

Gateway 110 is capable of providing video to one or more televisions and provides video programming to a first

television 106 through a gateway to first television connection 128. In a preferred embodiment the gateway to first TV connection is an S-video connection operating over an S-video cable. Gateway 110 is also capable of providing video signals to other televisions, such as a second television 108 and can do so via a gateway-splitter connection 126, splitter 124 and splitter to second television connection 127. A gateway which supports multiple analog televisions from one received digital stream is described in detail in US Patent Application 09/026,036 entitled "Video, Data and Telephone Gateway," of which Thomas Eames and Charles Eldering are the inventors, which is incorporated herein by reference.

Although the switched digital network illustrated in FIG. 1 is based on the use of twisted wire pair connections the invention is not limited to the use of a DSL based switched digital platform. When used herein the term switched digital refers to any type of local loop communications system in which video or data services are switched at a centralized location rather than being broadcast simultaneously to a plurality of subscribers. Switched digital platforms can be based on Fiber-to-the Curb (FTTC), Fiber-to-the-Home (FTTH) or other types of networks and can include coaxial, fiber-optic or other type of connections to residence 100. Switched digital networks are well understood by those skilled in the art.

In operation the system illustrated in FIG. 1 allows the reception of a plurality of broadcast channels at gateway 110 from the satellite/wireless antenna 120 via a

satellite/wireless receiver connection 118. In a preferred embodiment the satellite/wireless receiver connection 118 is a coaxial cable running from satellite/wireless antenna 120 to gateway 110.

Depending on the bandwidth provided by the DSL connection in the switched digital platform data or data and video services are available to gateway 110. In an ADSL system operating at 6 Mb/s a limited number of video channels can be transported simultaneously over the DSL system. By providing access to broadcast programming simultaneously with access to switched digital programming the user can access either type of channels through gateway 110.

In operation a user selects a channel at residence 100, with the request being transmitted to gateway 110 via an infrared, wireless, or coaxial signal originating from a remote control. Methods for transmitting channel selections to a gateway is described in detail in US Patent Application 09/525,488 entitled "Method and Apparatus for Transmitting Wireless Signals Over Media" and US Patent Application 09/526,100 entitled "Optical Conversion Device", which are both incorporated herein by reference. Gateway 110 determines if that channel is part of the broadcast lineup or needs to be requested from the switched digital platform. In a preferred embodiment the channel request is transmitted over the DSL connection to BDT 166 which contains software capable of authorizing or denying the subscriber channel request. In addition to authorizing or denying the subscriber request the BDT 166 can determine

if the channel is already being received over ATM network 172, or if it must be requested from a video server. BDT 166 is capable of receiving a plurality of broadcast channels via ATM network 172 but may also request specialized programs in support of Video on Demand (VoD) services. In this way the subscriber has access to both broadcast and switched digital programming and can simultaneously receive broadcast channels and one or more switched digital channels.

In an alternate embodiment gateway 110 can determine if a selected channel is part of the broadcast lineup, and has authority to grant access to that channel locally without transmitting the channel request to BDT 166. In this embodiment traditional satellite based security can be utilized to prevent unauthorized access to satellite or other broadcast services. The security systems are based on the use of transmitted keys which prevent gateway 110 from decoding unauthorized services. Security systems for broadcast entertainment services are well known to those skilled in the art.

FIG. 2 illustrates a use case diagram for a wireless xDSL gateway such as gateway 110 illustrated in FIG. 1. Use case diagrams are part of the Unified Modeling Language (UML) and are useful in describing systems, software, and methods of doing business. As shown in FIG. 2, a customer 200 interacts with this system which contains a receive channel request function 218, a determine channel source function 220, and a decoding and present channel function 222. The system also contains a demodulated

satellite/wireless signal function 210 which is capable of receiving and demodulating broadcast signals provided by a satellite/wireless service provider 204. An xDSL service provider 208 interacts with a request channel authorization function 212 and a receive channel authorization function 214 for controlling which channels customer 200 is authorized access to receive. The wireless xDSL gateway system also contains a demodulate xDSL signal function 216.

FIG. 3 illustrates a use case diagram for a wireless and xDSL control system. The wireless and xDSL control system is the system and software which provides the entire service functionality to customer 200. In a preferred embodiment the wireless and xDSL control system is distributed between gateway 110 and BDT 166. The wireless and xDSL control system contains a generate authorization tables function 316 which contains information relating to which channels customer 200 is entitled to receive. This information is frequently referred to as entitlement information. The wireless and xDSL control system also contains a receive channel request function 318, a transmit authorization function 320, and a transmit channel function 322. The transmit channel function 322 transmits the requested channel over the xDSL or other switched digital platform to customer 200.

The wireless and xDSL control system also contains a receive satellite/wireless channel lineup function 310 which enables satellite wireless service provider 204 to transmit information regarding the broadcast channel lineup. A receive xDSL channel lineup function 312

receives a channel lineup from xDSL service provider 208 and contains the channels or video server access which are provided by the switched digital system. A billing entity 300 can also communicate with a receive billing records function 314 which indicates if a customer has been paying for a service and can continue to receive a particular channel or lineup of channels.

FIG. 4 illustrates a sequence diagram useful for understanding the authorization sequence for the wireless and xDSL gateway system. As shown in FIG. 4 a remote control object entitled Remote:Tx 400 transmits a channel change request message tx(c) 450 for channel c to a remote control receive object Remote:Rx 410. Remote control receive object Remote:Rx 410 is located in gateway 110 and sends a gateway channel change request message tx(c) 452 to a source object Source 420 in gateway 110 which is capable of determining if the channel change request is for a broadcast channel available locally or is for a channel which must be delivered through the switched digital platform. Source 420 transmits a request local channel message requestL(c) 454 to an authorization gateway object Authorization:GW 430 which can return an authorization authorizeL(c) message 456 which permits the gateway 110 to decode and present the channel to the subscriber.

If the channel is not part of the broadcast lineup a request remote message requestR(c) 458 is sent to an authorization object in the BDT entitled Authorization:BDT 440. Authorization:BDT 440 can return an authorize remote

channel authorization signal in an authorizeR(c) message 460.

FIG. 5 illustrates an architecture for a preferred embodiment of a wireless/xDSL residential gateway. As shown in FIG. 5 the wireless/xDSL gateway has an input for broadcast signals which may be received in a direct broadcast satellite/digital video broadcast (DBS/DVB) format, LMDS format, or other broadcast format. The signals are received at a DBS triple tuner 510 which is capable of tuning three separate frequency segments in the broadcast spectrum. The output of DBS triple tuner 510 is received by the DBS/LMDS/DVB format processor 512 which is capable of receiving digital video in DBS/LMDS/DVB formats. The output of DBS/LMDS/DVB format processor 512 is received by an MPEG buffer 516 which stores digital video MPEG packets until they can be decoded by MPEG decoder 530, which is capable of supporting audio and video decoding. The output of MPEG decoder 530 is received by an audio/video input/output modulation device 534, which is capable of presenting the video in a variety of formats including RF modulated onto a known channel (e.g. channel 3), an National Television Standards Committee (NTSC) baseband signal, or an S video signal. Audio/video input output modulation device 534 can also generate audio baseband signals and other specialized video and audio output formats.

Data and graphics can also be received by DBS triple tuner 510 and are processed by a Reduced Instruction Set Computer (RISC) CPU 518 and subsequently processed by a

graphics accelerator RISC engine 520. Graphics and data signals are then sent to a graphics control device 532 and passed on to the audio/video input/output modulator device 534 for presentation on the television or monitor.

The wireless/xDSL residential gateway depicted in FIG. 5 also receives xDSL signals from a twisted wire pair connection at xDSL processor 514. The xDSL processor 514 can support cell reception in a variety of standardized formats including G.lite, ADSL, and VDSL. The xDSL processor 514 also contains an Asynchronous Transfer Mode Segmentation And Reassembly (ATM SAR) processor which allows for reconstruction of MPEG packets from the ATM based xDSL signal. Although xDSL processor 514 has been described as being based on standardized xDSL transmission schemes, nonstandardized transmission formats can also be utilized for transmission and reception of the xDSL signal, and can be supported by specialized versions of xDSL processor 514. As was the case for data and graphics received over the broadcast channel, data and graphics received over the xDSL line can be processed by the main RISC CPU 518 and the graphics accelerator RISC engine 520.

The receivers, format processors, MPEG buffer 516 main RISC CPU 518, and graphics accelerator RISC engine 520 are all connected to an I/O control CPU 522 which supports communication of gateway 110 with a variety of external devices including derived Plain Old Telephony services (POTs) devices which can provide analog telephony signals, 10BaseT/Home Network Interface (HNI) connection, Universal Serial Bus (USB), smart card, IDE or SCSI hard drive

interfaces, Firewire (IEEE 1394), a front panel, IR blaster, other devices known to one of skill in the art and a wireless, infrared, or wired remote control. In addition, a memory control until 524 is connected to the various subsystems in the wireless/xDSL residential gateway and supports use of a PCI card through a PCI bus.

As shown in FIG. 5, a plurality of MPEG decoders 530, graphics control devices 532, and audio/video input/output modulation devices 534 can be supported in the wireless/xDSL residential gateway. In this way multiple televisions in the residence can be supported from a reception of a broadcast stream, a switched video stream, or combination of the two. As shown in FIG. 5 not all of the video formats need to be supported from the audio/video input/output modulator device 534 and as a cost savings measure some of the video modules may only support a limited subset of interfaces.

In an alternate embodiment an FTTC system delivers video signals across a coaxial cable which does not use an xDSL format. In this case xDSL processor 514 is replaced by a FTTC processor. Similarly, other types of input processors can be used to support FTTH or other local loop switched network architectures.

FIG. 6 illustrates a preferred embodiment of a gateway device in the form of an integrated circuit gateway processor (ICGP) 680 which can be used to realize many of the function of the wireless/xDSL residential gateway shown in FIG. 5. One of the advantages of the integrated circuit gateway processor 680 shown in FIG. 6 is that it can

provide the core functions for video and graphics processing, independent of the external media and transmission/reception technique. As shown in FIG. 6 external media dependent devices 690 can be utilized to receive DVB, DBS, (or other xDSL) cable signals in the form of digital cable signals or according to the Data Over Cable System Interface Specification (DOCSIS), or MMDS/LMDS signals. In a preferred embodiment the signals are received over a standardized interface such as an ATM UTOPIA interface 624 or a DOCSIS interface 622.

The ICGP 680 supports video functions by receiving a demodulated signal containing MPEG packets, and decoding the MPEG packets in an MPEG/ACTV decoder 608. MPEG/ACTV decoder support a variety of digital video formats including all of the standard definition and high definition formats specified by the Advanced Television Systems Committee (ATSC). The audio is processed in an MPEG/AC-3 audio processor 610 and the graphics are processed in a graphics engine 612. An integratable analog system 606 supports the final conversion to an analog signal. This analog signal is broadcast to the primary TV through a primary TV interface subsystem 600. For the second and third televisions an auxiliary TV1 interface subsystem 602 and an auxiliary TV2 interface subsystem 604 are utilized. In this way a number of analog televisions can be supported from one received digital video stream as previously described.

ICGP 680 utilizes a RISC engine 620 in conjunction with a RISC SAR 630 to process ATM cells containing MPEG

packets. If the external media dependent devices 690 produce an MPEG stream as output, the stream is processed directly by RISC engine 620. RISC engine 620 passes on the MPEG cells for decoding by one of the MPEG decoders 608. ICGP 680 supports an interface to a remote control device through a remote control interface processor 650 which is connection to an IR interface 652 or a UHF interface 654. External receivers for the reception of the IR or radio frequency radiation are used to convert the signal to an electrical signal compatible with IR interface 652 or UHF interface 654.

ICGP 680 also supports the processing of data and permits data to be transmitted out of the ICGP 680 device to external devices. This functionality is supported both by it RISC SAR 630 which interfaces directly to an isochronous port 648 for (POTs). An Ethernet/USB/Firewire engine 640 supports transmission of data in a variety of formats off the chip including interfaces to a 10/100BaseT port 642, a USB port 644 and a Firewire port 646.

FIG. 7 illustrates an in-home distribution system using a wireless and xDSL residential gateway with distributed receiving devices that permits reception of signals from a main host residential gateway 700 by a plurality of in-home devices including full functionality digital television set-tops, low-cost digital television set-tops, and computers 114.

As illustrated in FIG. 7 a main host residential gateway 700 is connected to a satellite/wireless antenna 120 which receives signals from a broadcast source which

may be a satellite, LAN-based wireless transmitter or other broadcast source. The broadcast source may be transmitting a variety of services in different formats. These services can include traditional broadcast channels, Near Video on Demand (NVoD) services, ACTV or Advanced systems Television (ATSC) format signals, or Standard Definition or High Definition Digital Television (SD/HD TV) signals.

The main host residential gateway 700 also interfaces to a switched network which may be a DSL network, FTTC, FTTH or other switched infrastructure. In a preferred embodiment the switched infrastructure is an ADSL network in which signals are transmitted directly from a central office over outside plant twisted wire pairs 150. DSL signals are received at a diplex filters 702 which separates out telephone signals 710 which are received by logic block 712.

The digital signal is received by a DSL processor which can be an ADSL processor 708 or a VDSL processor 706. A RISC processor 720 is used in conjunction with Synchronous Dynamic Random Access Memory (SDRAM) 722 and an external memory 724 to generate decompressed MPEG signals which are processed by a video/audio input/output processor 734. In a preferred embodiment RISC processor 720 is MAP-CA device made by the Equator Corporation having a line width of 0.18 um and operating at 300 MHz. Alternate RISC processors including those manufactured by the MIPS Corporation or ARM Ltd. can be utilized and are well known to those skilled in the art. The output of video audio input/output processor 734 is directed at a television 106.

The second video audio processor 732 can be utilized for additional video processing.

RISC processor 720 is able to support a large variety of services using flexible software which can run on a number of different operation systems. RISC processor 720 supports services including H.323 video conferencing, display of graphics, and software based audio/video functions. RISC processor 720 also connects to a telephone line interface 780 which can support isochronous or Internet protocol (IP) based telephone services. These services are provided to derived POTs line interfaces 782.

Broadcast signals received from satellite/wireless antenna 120 are processed by a broadcast signal receiver 704. The MPEG packets are subsequently processed by RISC processor 720. A power supply 740 is used to power the various devices in the main host gateway and is connected to an external power source via an AC converter 742.

In the gateway system illustrated in FIG. 7 signals can be distributed to devices in the home over inside twisted wire pairs 112. This allows use of the existing home wiring for the distribution of video signals and is based on the use of a Home Network Interface (HNI) device 730. HNI devices 730 are based on the transmission of digital signals over twisted wire pairs using a suitable modulation format and standardized protocols. In a preferred embodiment the digital signal is a 20 Mb/s signal transmitted above the POTs spectrum in a VDSL like modulation format and is based on Internet protocols in an IEEE 802.3 compliant data format. A Quality of Service

(QoS) functionality is supported such that video signals can arrive at the remote devices uninterrupted.

At the remote devices the HNI signals are received at a home network modem 750 or at an HNI network interface card 752 which is plugged into computer 114. Remote television decoders include a low-cost remote decoder 752 and a full ATSC compliant remote decoder 750. The full ATSC compliant remote decoder 750 is capable of receiving all digital television formats including HDTV formats, while the low-cost remote decoder 752 only decodes a subset of the ATSC digital formats. A home network interface device 730 is used to receive data from the main host residential gateway 700 over the in-home twisted wire pairs 112.

As shown in FIG. 7 the full ATSC compliant remote decoder 750 contains the home network interface device 730 and a RISC processor 720. In a preferred embodiment RISC processor 720 is an MAP-CA processor while in an alternate embodiment the RISC processor is a SGS Thompson ST7000 RISC processor. SDRAM 722 provides memory for reception of the HNI signal as well as for MPEG decoding. A video/audio input/output device 734 is used to generate a signal which is compatible with an analog television.

The low-cost remote decoder 752 contains a home network interface device 730, matching logic 754 and the low-cost MPEG processor 756. In a preferred embodiment the low-cost MPEG processor is an SGS Thompson 5505 MPEG processor. SDRAM 722 is used to support the MPEG processing and the resulting decoded video signal is sent

to a video/audio input/output device 734 for converted to analog format compatible with an analog television. Power is provided by a power module 740 which is connected to an external power source. In an alternate embodiment the low cost remote decoder or ATSC compliant remote decoder 750 are powered by the television set.

One advantage of the present invention is that it can be utilized to receive broadcast and DSL video signals and can distribute those signals to a number of televisions or computers in the home using existing twisted wire pairs in the home. This permits reception of a variety of television channels including local channels and allows reception of multiple programs by televisions in different locations of the home.

Referring to the preferred embodiment depicted in FIG. 7, a subscriber can have a second television 108 which is connected to the main host residential gateway. In addition to being connected to the second television, the first television can receive the signal being sent to the second television 108. This can be accomplished through the use of a splitter 790 in conjunction with coaxial cables 792. One advantage of this configuration is that a subscriber can be viewing one program on first television 106 and receive programming directed at another television on the first television 106. As an example, the subscriber may be viewing an ADTV movie received from a satellite (DBS) system on the first television 106, and can view local channels received over the ADSL switched digital

video network on both the second television 108 and the first television 106.

As can be readily understood, viewers can watch different or identical channels in different parts of the house. The channels can be received over the switched network or over the broadcast network. As an example, a family may be viewing a movie which may be in a high definition format received over the broadcast (e.g., satellite) network while someone is watching a local news program upstairs. The present invention allows reception of the local channel over the switched (e.g., DSL) network while simultaneously permitting reception of the broadcast programming over the satellite network. When the existing wiring is utilized for the transmission of digital signals in the home, low cost remote decoders can be used in the secondary television locations.

Although this invention has been illustrated by reference to specific embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made that clearly fall within the scope of the invention.

Claims

What is claimed is:

1. In a telecommunications system, a method for using a residential gateway device comprising the steps of:

receiving a request for a signal at the gateway device;

determining whether the request is for a broadcast signal or a switched digital signal;

transmitting the request from the gateway device to a switched digital signal source in response to a determination that the request is for a switched digital signal;

receiving at the gateway device a signal transmitted from the switched digital signal source in response to the request transmitted to the switched digital signal source; and

transmitting the switched digital signal using the gateway device.

2. In a telecommunications system, a method for using a residential gateway device comprising the steps of:

receiving a request for a signal at the gateway device;

determining whether the request is for a broadcast signal or a switched digital signal;

receiving at the gateway device, in response to a determination that the request is for a broadcast signal, the broadcast signal; and

transmitting the broadcast signal using the gateway device.

3. The method of claim 2, further comprising the step of decoding the broadcast signal in response to receiving the broadcast signal, wherein the step of transmitting the broadcast signal includes the step of transmitting the decoded broadcast signal using the gateway device.

4. In a telecommunications system, a method for using a residential gateway device in communication with a broadcast signal source and a switched digital signal source, said method comprising the steps of:

receiving a request for a signal at the gateway device;

determining whether the request is for a broadcast signal or a switched digital signal;

transmitting, in response to the request-determining step, an authorization request to a centralized controller;

determining whether the gateway device is authorized to receive the requested signal;

if the requested signal is a broadcast signal,

transmitting, responsive to the authorization-determining step, an authorization message;

receiving the broadcast signal at the gateway device;

decoding, responsive to the authorization message, the broadcast signal; and

transmitting the decoded broadcast signal; and

if the requested signal is a switched digital signal,

transmitting, responsive to the authorization-determining step, the switched digital signal from the switched digital signal source to the gateway device;

receiving the switched digital signal at the gateway device; and

transmitting the switched digital signal.

5. In a telecommunications system, a method for using a residential gateway device comprising the steps of:

receiving a request for a signal at the gateway device;

determining whether the request is for a broadcast signal or a switched digital signal;

transmitting, in response to the request-determining step, an authorization request for the broadcast signal from the gateway device to a centralized controller;

determining, in response to the authorization request, whether the gateway device is authorized to receive the broadcast signal;

transmitting an authorization response from the centralized controller;

receiving the authorization response at the gateway device;

receiving a broadcast signal at the gateway device from a broadcast signal source;

decoding, in response to the authorization response, the broadcast signal at the gateway device; and

transmitting the decoded broadcast signal.

6. In a telecommunications system, a method for using a residential gateway device comprising the steps of:

receiving a request for a signal at the gateway device;

determining whether the request is for a broadcast signal or a switched digital signal;

transmitting, in response to the request-determining step, an authorization request for the switched digital signal from the gateway device to a centralized controller;

determining, in response to the authorization request, whether the gateway device is authorized to receive the switched digital signal;

receiving at the gateway device, in response to the authorization-determining step, a switched digital signal from a switched digital signal source; and

transmitting the switched digital signal.

7. In a telecommunications system, a method for using a residential gateway device comprising the steps of:

receiving a request for a first signal and a request for a second signal at the gateway device;

determining that the request for a first signal is for a broadcast signal;

determining that the request for a second signal is for a switched digital signal;

sending, from the gateway device to a centralized controller, a first authorization request for the broadcast

signal and a second authorization request for the switched digital signal;

determining, in response to the first authorization request, whether the residential gateway device is authorized to present the broadcast signal and, in response to the second authorization request, whether the gateway device is authorized to present the switched digital signal;

sending, responsive to the authorization-determining step, an authorization message from the centralized controller to the gateway device;

receiving at the gateway device the broadcast signal from a broadcast signal source;

decoding, in response to the authorization message, the received broadcast signal;

transmitting the decoded broadcast signal;

receiving at the gateway device, in response to the authorization message, the switched digital signal from a switched digital source; and

transmitting the received switched digital signal.

8. In a telecommunications system, a method for using a residential gateway device comprising the steps of:

receiving a request for a first signal and a request for a second signal at the gateway device;

determining that the request for a first signal is for a first broadcast signal;

determining that the request for a second signal is for a second broadcast signal;

sending, from the gateway device to a centralized controller, a first authorization request for the first broadcast signal and a second authorization request for the second broadcast signal;

determining, in response to the first authorization request, whether the residential gateway device is authorized to present the first broadcast signal and, in response to the second authorization request, whether the gateway device is authorized to present the second broadcast signal;

sending, responsive to the authorization-determining step, an authorization message from the centralized controller to the gateway device;

receiving at the gateway device the first broadcast signal and the second broadcast signal from a broadcast signal source;

decoding, in response to the authorization message, the received first broadcast signal and the received second broadcast signal;

transmitting the decoded first broadcast signal and the decoded second broadcast signal.

9. In a telecommunications system, a method for using a residential gateway device comprising the steps of:

receiving a request for a first signal and a request for a second signal at the gateway device;

determining that the request for a first signal is for a first switched digital signal;

determining that the request for a second signal is for a second switched digital signal;

sending, from the gateway device to a centralized controller, a first authorization request for the first switched digital signal and a second authorization request for the second switched digital signal;

determining, in response to the first authorization request, whether the residential gateway device is authorized to present the first switched digital signal and, in response to the second authorization request, whether the gateway device is authorized to present the second switched digital signal;

sending, responsive to the authorization-determining step, an authorization message from the centralized controller to the gateway device;

receiving at the gateway device, in response to the authorization message, the first switched digital signal and the second switched digital signal from a switched digital source; and

transmitting the received first switched digital signal and the received second switched digital signal.

10. A residential gateway comprising:

a broadcast receiver for receiving at least one broadcast signal;

a switched digital receiver for receiving at least one switched digital signal;

a channel request receiver;

means for determining whether a requested channel is a broadcast signal or a switched digital signal; and

means, responsive to said determining means, for presenting the requested channel.

11. The residential gateway of claim 10, further comprising means, in communication with said channel request receiver, for determining whether the residential gateway is authorized to present the requested signal.

12. The residential gateway of claim 11, wherein the authorization-determining means comprises a centralized controller.

13. The residential gateway of claim 10, further comprising means for decoding the received broadcast signal.

14. The residential gateway of claim 10, further comprising means for demodulating the received broadcast signal.

15. The residential gateway of claim 10, further comprising means for demodulating the received switched digital signal.

16. The residential gateway of claim 10, wherein the switched digital receiver comprises a high-definition-television-signal receiver.

17. The residential gateway of claim 10, wherein the presentation means comprises means for simultaneously presenting a plurality of signals.

18. The residential gateway of claim 10, wherein the presentation means comprises twisted wire pair cable.

19. The residential gateway of claim 10, wherein the presentation means comprises coaxial cable.

20. The residential gateway of claim 10, further comprising an interface for transmitting the requested signal to a computer.

21. The residential gateway of claim 10, wherein the broadcast receiver comprises a tuner.

22. The residential gateway of claim 10, wherein the broadcast receiver comprises a format processor.

23. The residential gateway of claim 10, wherein the broadcast receiver comprises a plurality of MPEG buffers and a plurality of MPEG decoders.

24. The residential gateway of claim 10, wherein the broadcast receiver comprises a RISC CPU, a graphics accelerator RISC engine, and a graphics controller.

25. The residential gateway of claim 10, wherein the switched digital receiver comprises an xDSL format processor.

26. The residential gateway of claim 24, wherein the xDSL format processor comprises an asynchronous transfer mode segmentation and reassembly processor.

27. The residential gateway of claim 10, wherein the switched digital receiver comprises a RISC CPU, a graphics accelerator RISC engine, and a graphics controller.

28. The residential gateway of claim 10, wherein the switched digital receiver comprises a FTTC format processor.

29. The residential gateway of claim 10, wherein the switched digital receiver comprises a FTTH format processor.

30. The residential gateway of claim 10, wherein the switched digital receiver comprises means for separating telephone signals from video and data signals.

31. The residential gateway of claim 30, wherein the signal separating means comprises a diplex filter.

32. The residential gateway of claim 10, wherein the presentation means comprises a plurality of audio/visual modulation devices.

33. A telecommunications system for providing broadcast and switched digital signals, comprising:

a broadcast reception antenna;

a switched digital network;

a residential telecommunications gateway in connection with the broadcast reception antenna and the switched digital network, wherein the gateway receives and processes broadcast signals from the broadcast reception antenna and receives and processes switched digital signals from the switched digital video network; and

a Home Network Interface for distributing the received and processed signals as HNI signals.

34. The telecommunications system of claim 33, wherein the residential telecommunications gateway comprises

a broadcast receiver for receiving at least one broadcast signal,

a switched digital receiver for receiving at least one switched digital signal,

a channel request receiver,

means for determining whether the requested channel is a broadcast signal or a switched digital signal, and

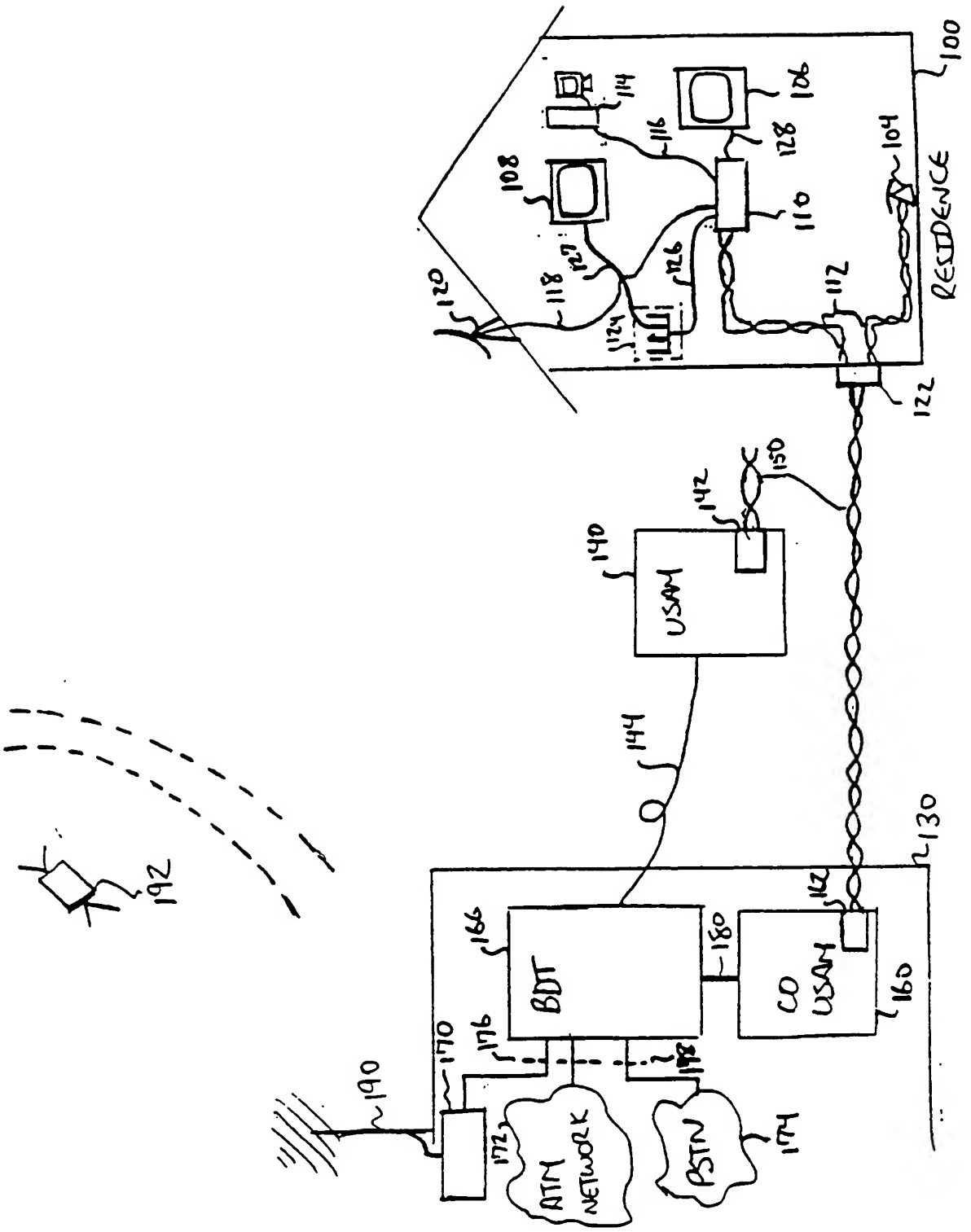
means, responsive to the determining means, for presenting the requested channel.

35. The telecommunications system of claim 33, further comprising a home network modem for receiving HNI signals.

36. The telecommunications system of claim 33, further comprising a HNI network interface card for receiving HNI signals at a computer.

37. The telecommunications system of claim 33, wherein the switched digital network comprises an xDSL network.

38. The telecommunications system of claim 33, wherein the switched digital signals comprise high-definition television signals.


100
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BDT
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ATM NETWORK
PSTN

FIG. 1

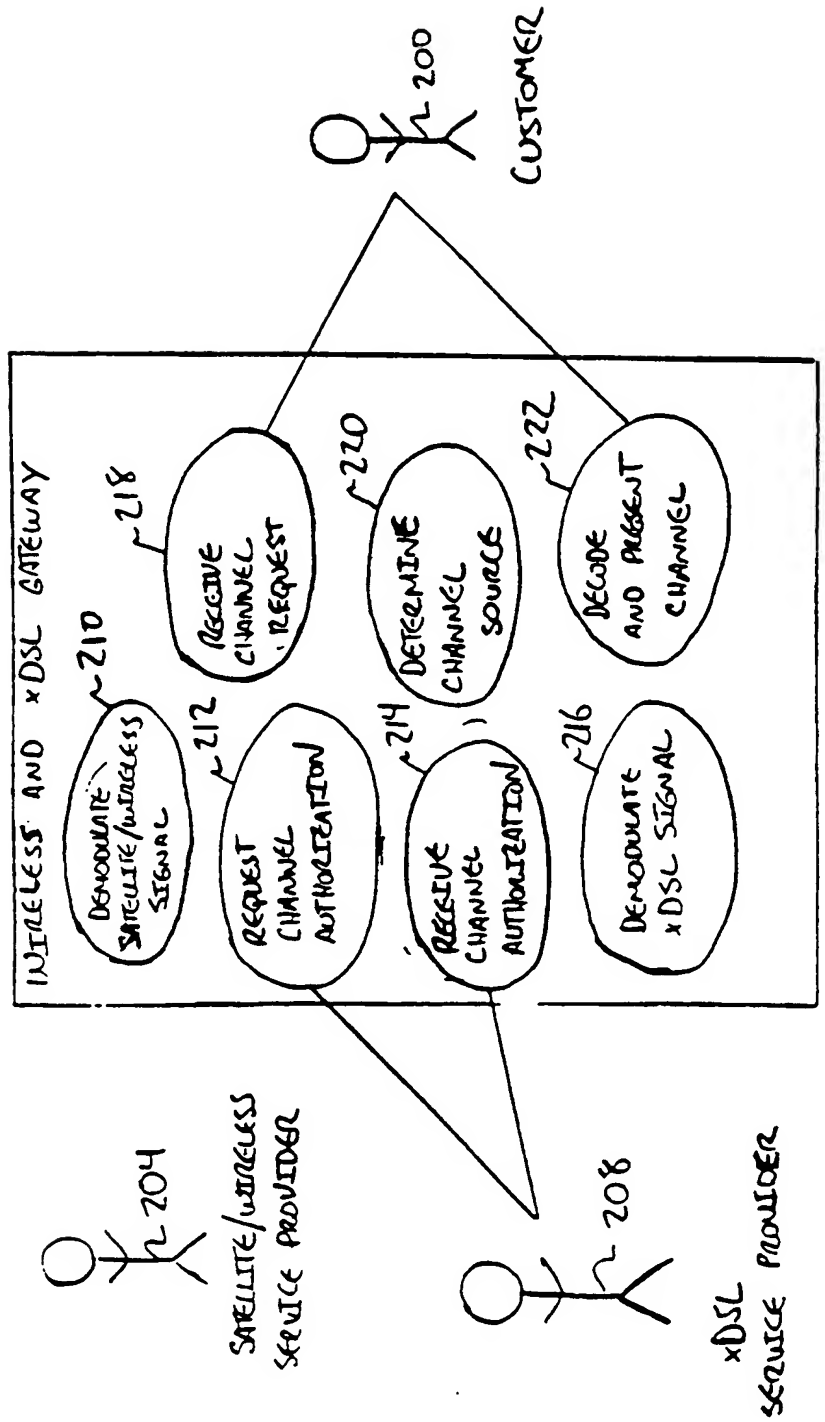


FIG. 2

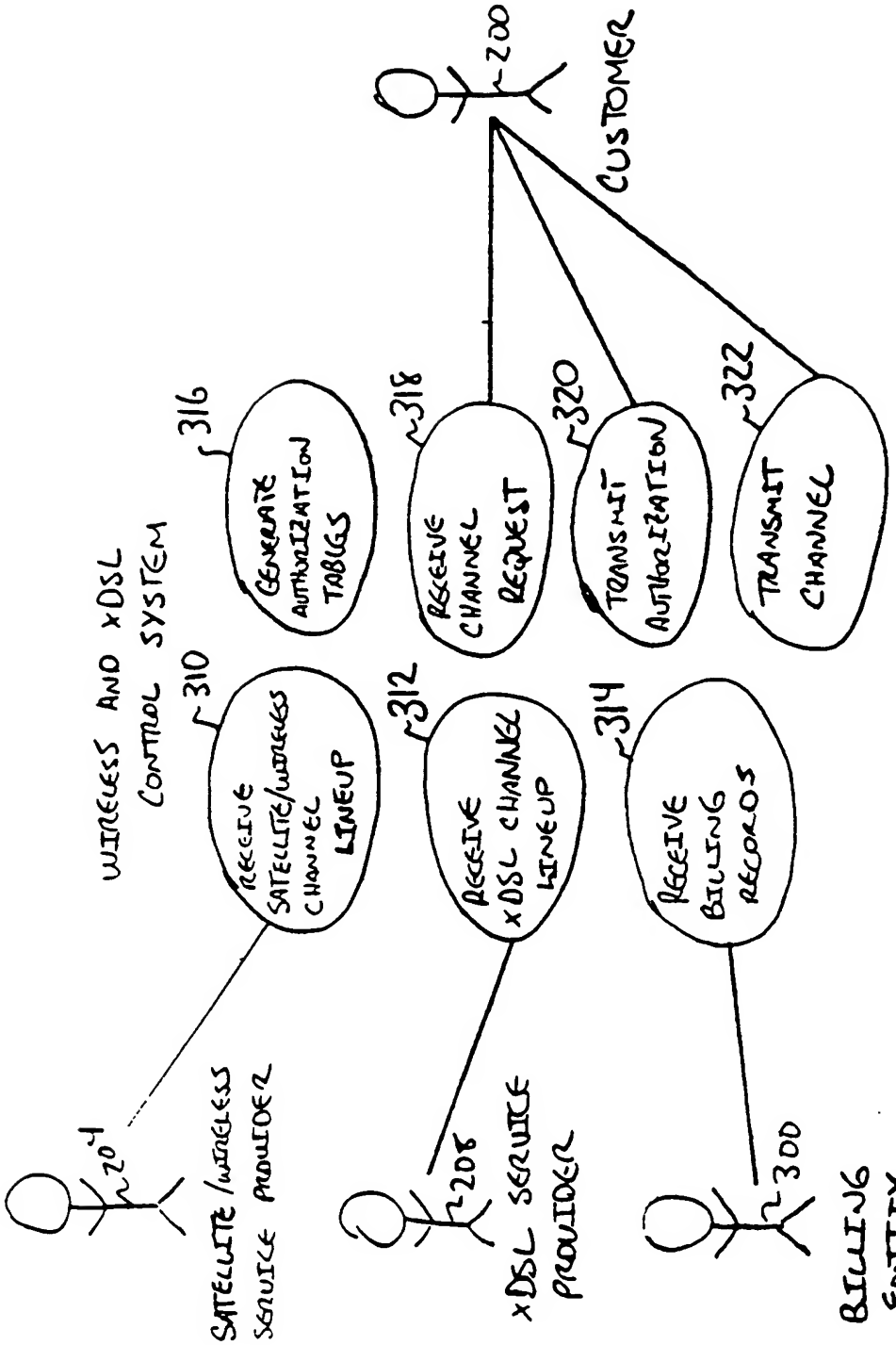


FIG. 3

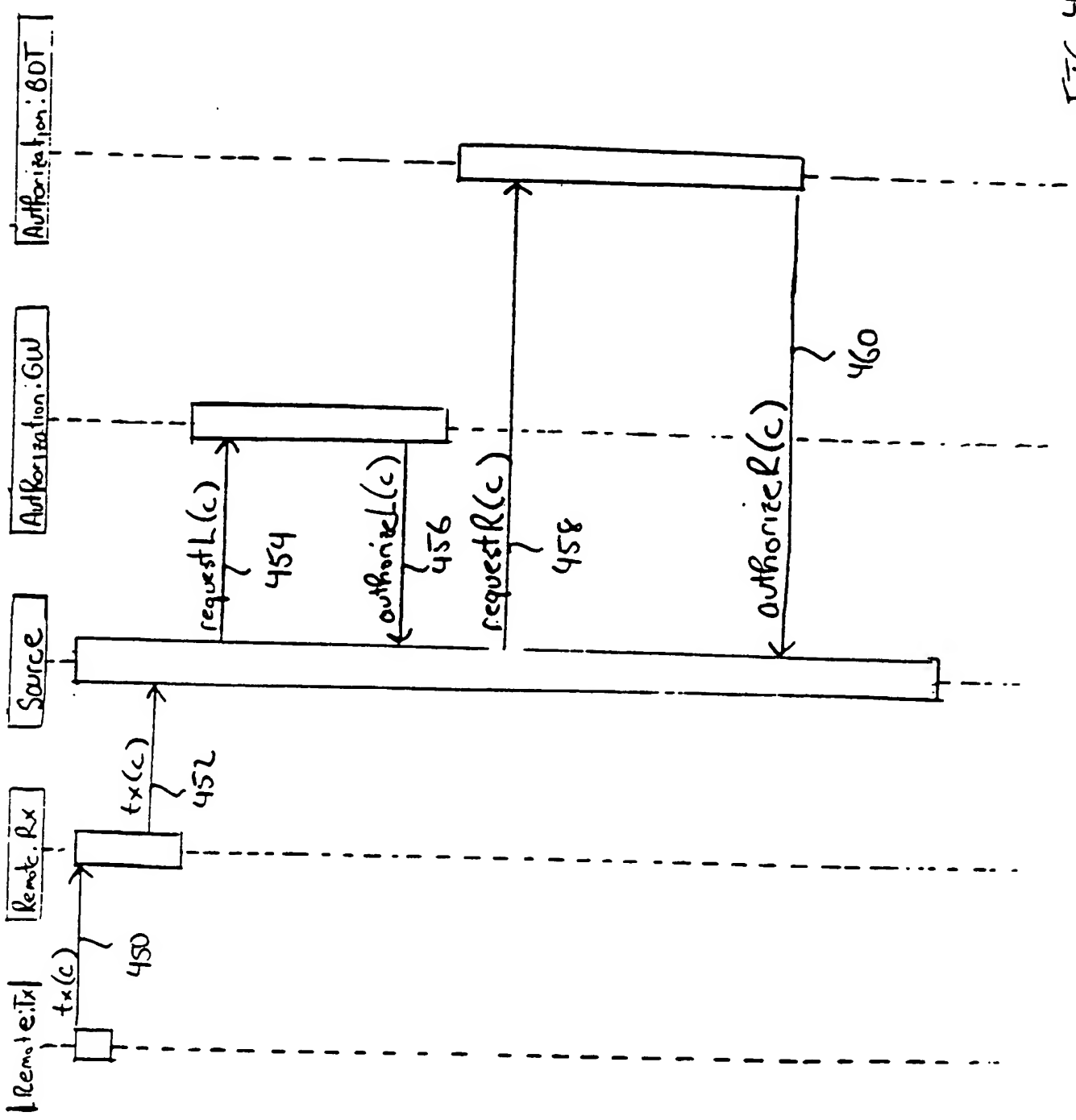
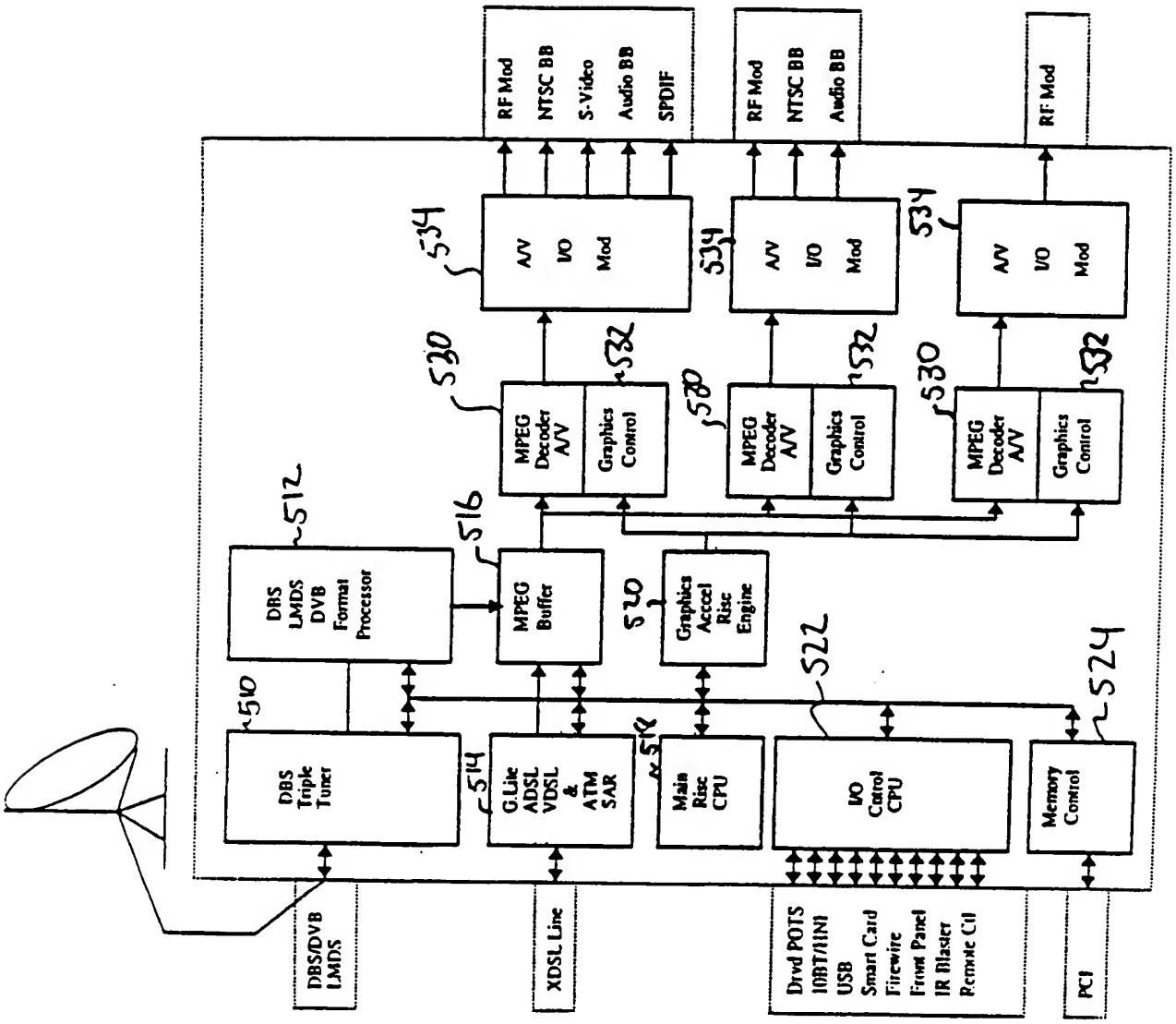


FIG. 4



Wireless/xDSL RG

FIG. 5

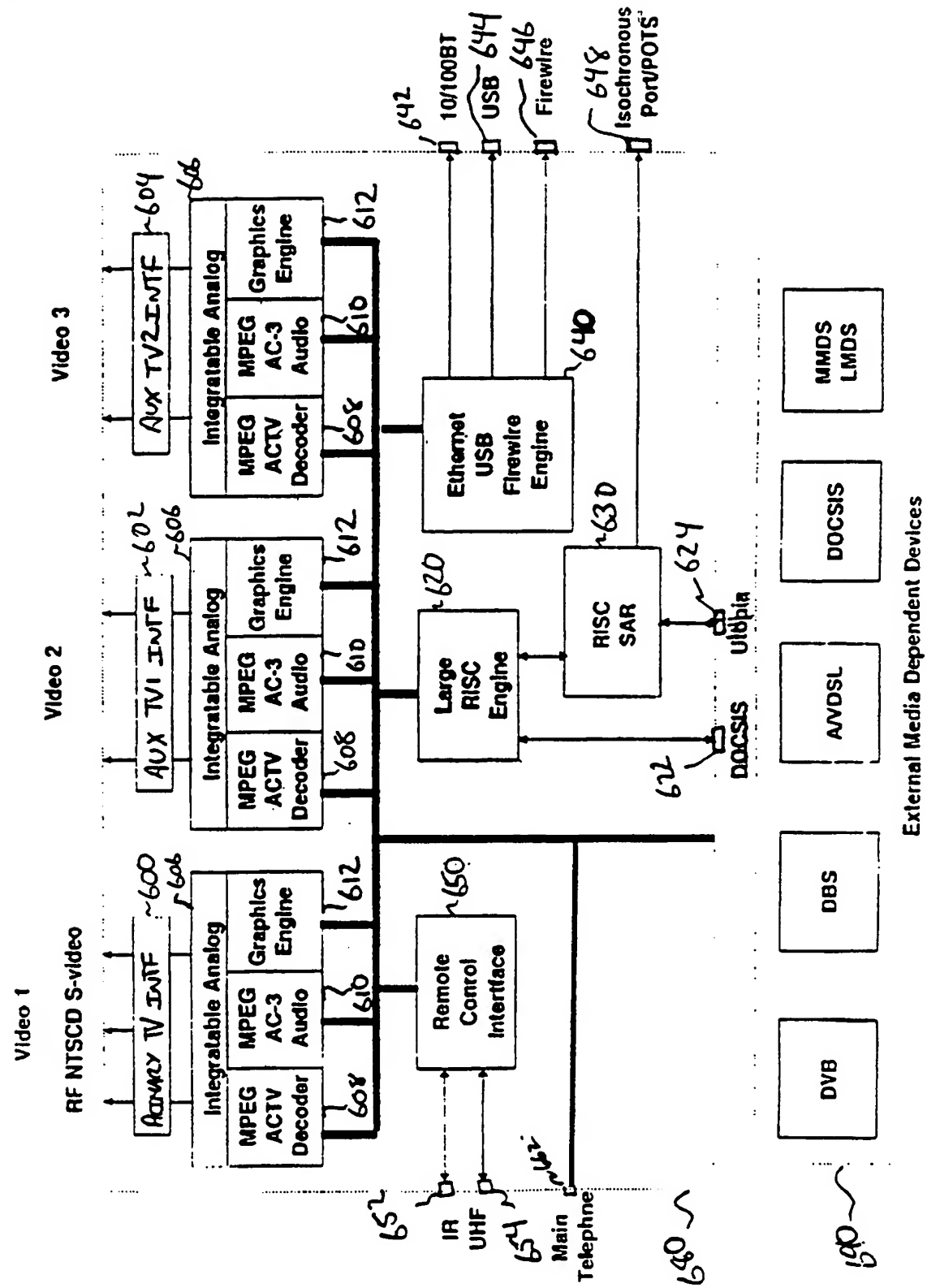
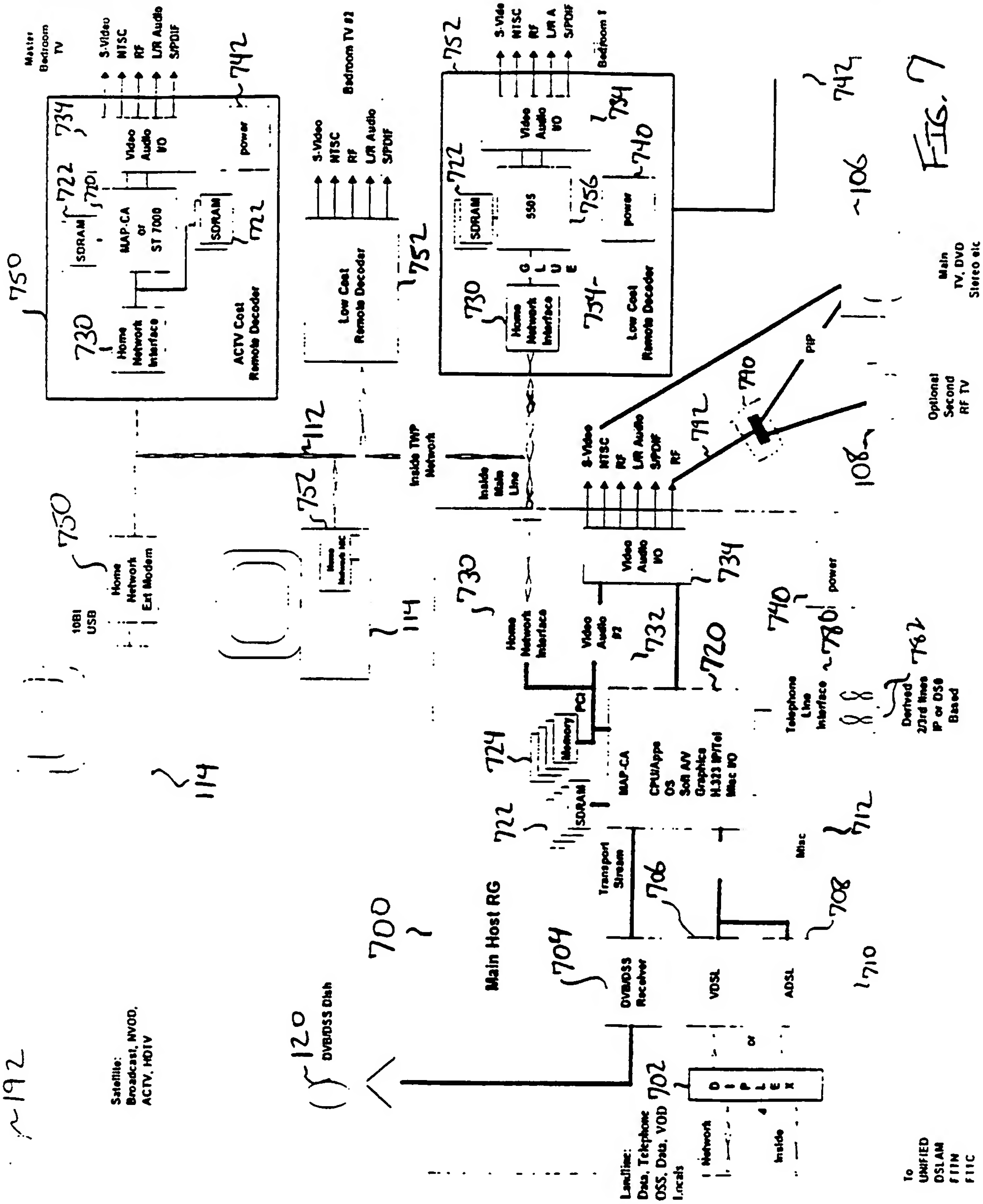


FIG. 6


Master Bedroom TV
S-Video
NTSC
RF
L/R Audio
S/PDIF
Bedroom TV #2
Bedroom 1
Home Network Interface
MAP-CA or ST 7000
SDRAM
Video Audio I/O
power
ACTV Cost Remote Decoder
Low Cost Remote Decoder
5505
GLUE
Inside TWP Network
Inside Main Line
Home Network Ext Modem
10BT USB
Main TV, DVD Stereo etc
PIP
Optional Second RF TV
Video Audio #2
PCI
Memory
MAP-CA
CPU/Apps OS Soft A/V Graphics H.323 IP/Tel Misc I/O
Transport Stream
Telephone Line Interface
Derived 2/3rd lines IP or DS0 Based
Misc
Main Host RG
DVB/DSS Receiver
VDSL
ADSL
DVB/DSS Dish
Satellite: Broadcast, NVOD, ACTV, HDTV
DIPLEX
Landline: Data, Telephone OSS, Data, VOD Locals
Network
Inside
To UNIFIED DSLAM FTTN FTTC
FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/40329

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :H04N 7/173
US CL :345/327; 455/4.2

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/327; 455/4.2-6.3; 348/6-13; H04N 7/16, 7/173; 709/219

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,828,403 A (DERODEFF et al.) 27 October 1998 whole document	1-38
Y	US 5,892,508 A (HOWE et al.) 06 April 1999 figure 1 and columns 7-9	1-38
Y	US 5,608,447 A (FARRY et al.) 04 March 1997 column 10, line 63 - column 11, line 45	4-9,11,12
A	US 5,715,020 A (KUROIWA et al.) 03 February 1998 figure 40	1-38
A	US 5,579,308 A (HUMPLEMAN) 26 November 1996 whole document	1-38

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
29 SEPTEMBER 2000	23 OCT 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer CHRISTOPHER GRANT Telephone No. (703) 305-4755

Form PCT/ISA/210 (second sheet) (July 1998) *